Savage and Prescott Simulation

Savage and Prescott Simulation

Benchmark Description

May 25, 2010

Benchmark problem description.

Summary

This benchmark problem computes the viscoelastic (Maxwell) relaxation of stresses from repeated infinite, strike-slip earthquakes in 3D without gravity. The analytical solution for this problem is presented by Savage and Prescott (JGR, 1978). Although the analytical solution is for an elastic layer overlying a viscoelastic half-space assuming an infinitely long strike-slip fault, the problem can be very well approximated using a 3D finite element model. The problem is driven by a combination of constant velocities applied along the x-boundaries of the mesh, along with periodic (coseismic) fault slip applied along the upper (locked) portion of the fault and steady fault slip applied in the portion of the elastic layer below the locked section of the fault. Since the finite element solution is an approximation of a half-space solution, the mesh dimensions are somewhat arbitrary. The dimensions listed below, however, have been shown to provide a good fit to the analytical solution.

Problem Specification

PROBLEM GEOMETRY 3D

- Model size
  - -1000 km ? x ? 1000 km
  - -500 km ? y ? 500 km
  - -400 km ? z ? 0 km
    - Top layer (elastic): -40 km ? z ? 0 km
    - Bottom layer (viscoelastic): -400 km ? z ? -40 km

RTIES

c whereas the bottom layer is viscoelastic.

on solid, G = 30 GPa

? = 4.73364e19 Pa-s (yielding a relaxation time of 2?/G = 100 years)

xtending along the entire y-dimension of the model (-500 km ? y ? 500 km), with a depth extent of -40 km

ends from -20 km ? z ? 0 km, while the creeping section (blue) extends from -40 km ? z ? -20 km. Along
f the coseismic displacement and half of the steady creep is applied. On the locked portion of the fault, 4
 a complete release of the accumulated slip deficit over that time. On the creeping portion of the fault,
imulation.

On the x = -1000 km plane and the x = 1000 km plane, the y-velocities are set to -1 cm/year and +1
he x-displacements are set to zero on these planes, and they are also set to zero on the y = -500 km

(coarse resolution). A variable resolution mesh should also be tried. Options that have been used so far
ined region with extents of -240 km ? x ? 240 km; -120 km ? y ? 120 km; -100 km ? z ? 0 km. When
ahedral meshes and 10 km for tetrahedral meshes.

0, 50, 100, 150, and 190 years as well as the mesh topology (i.e., element connectivity arrays and
y to run the problem through multiple earthquake cycles to obtain a solution approximating the analytical
 up. Therefore, run the model through 9 earthquake cycles and then output the solution for the tenth

ng HDF5 files.

vage and Prescott (JGR, 1978). A Python utility to compute this solution is available in the
n input files, along with additional utilities and figures comparing analytical results with results using

```
benchmarks/trunk/quasistatic/sceccrustdeform/savageprescott
```